Mirror-Image Asymmetry
An Introduction to the Origin and Consequences of Chirality

James P. Riehl
MIRROR-IMAGE
ASYMMETRY
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An Introduction to the Origin and Consequences of Chirality

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To Cecelia, Patrick, and James;
and in memory of my mother Alice
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It is perhaps easy for some to not notice the symmetry or asymmetry in their everyday lives, but for someone like me, who has spent almost 35 years developing and using chemical and physical methods to study asymmetric molecules, to not see this aspect in my everyday view of the macroscopic world is impossible. There is certainly beauty in symmetry, whether it is in the spherical, radial, or bilateral symmetry of physical objects, or in the mathematics and equations that one needs to describe the most fundamental laws of nature. However, if one is able to understand the purposeful or programmed departure from symmetry, the world in my view becomes much more interesting and no less beautiful.

This book has been written in a way that parallels the development of my understanding and interests in chirality. It begins with the necessary definitions and language that is needed to communicate the structure of molecules related through their mirror image, and then, in Chapter 2, describes the early history of chirality in molecules found in living systems. Chapter 3 is a short summary of the various theories of the origin of chirality, and in Chapters 4 and 5 we present information concerning the role that chiral molecules play in the pharmaceutical industry and in sensory recognition and biochemical control. Beginning in Chapter 6 we leave the
molecular consequences of chirality, and begin a description of chirality in large-scale living systems. Chapter 7 deals with the right-handedness of human beings, and Chapter 8 is concerned with the consequences of a dominantly right-handed population in sports, windmills, and many other aspects of the chiral world that we inhabit.

The reader unfamiliar with basic chemistry and the way that chemists draw molecules should not be waylaid by all of the chemical drawings that are given in early chapters. Certainly, the ideas and principles may be understood without appreciation for the three-dimensional structures. The reader is especially encouraged to continue forward to Chapters 6–8, where photographs and diagrams of familiar objects are used to illustrate how chirality is present in the macroscopic world. Many readers who are far removed from their chemistry studies may benefit from the quick review of chemical structural drawings given in the short appendix at the end of the book.

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